

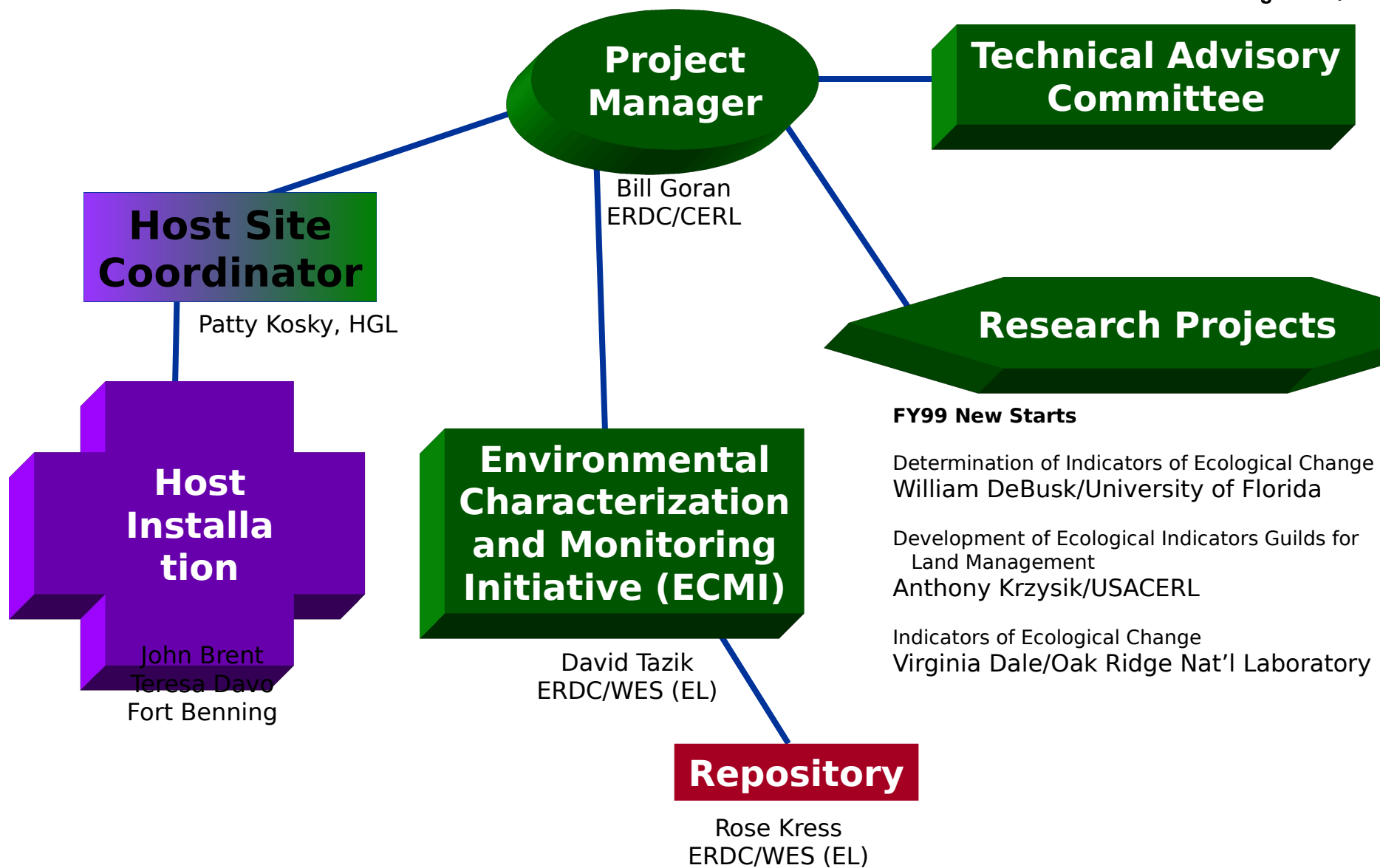
The SERDP Ecosystem Management Project CS-1114/7

**William D. Goran
U.S. Army Engineering Research
and Development Center (ERDC)
U.S. Army Construction Engineering Research
Laboratory (USACERL)**

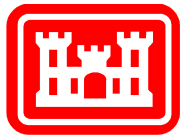
**SERDP In-Progress Review
26 April 1999**

SEMP Organization Chart

US Army Corps of Engineers®



Technical Advisory Committee for SEMP



US Army Corps
of Engineers®

- Mr. Peter Boice, Director of Conservation Programs,
Deputy
Undersecretary for Defense, Environmental Security
- Dr. Roger Dahlman, Program Manager, U.S. Department of
Energy
- Dr. Penny Firth, National Science Foundation
- Mr. Richard McWhite, Natural Resources Chief, Eglin Air
Force Base
- Ms. Kim Michaels, Army Environmental Center,
Conservation
- Dr. Sam Pearsall, Science Advisor, North Carolina Nature
Conservancy
- Dr. Doug Ripley, Headquarters, Air Force
- Dr. James Spotila, Chief Environmental Scientist, Assistant
Sec. of the Army (IL&E)
- Dr. J. Whitfield Gibbons, Savannah River Ecology Lab and
University of Georgia
- Ex Officio Members from SERDP, ERDC and Fort Benning

The Problem

Understanding of Ecosystem Management

- How does the ecosystem function?
- How do mission and protected resources interact?
- What are the thresholds of degradation?
- How might beyond-the-fenceline dynamics impact the mission?

Knowledge Gaps

Guidance for Ecosystem Management

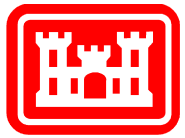
- DoD Guidance
- Services Guidance
- SIKES Act/Regs
- Endangered Species Act/Reg
- Public Concerns

Adaptive Management

Ecosystem Management Practices

- | | |
|-----------------------|-------------------------------|
| □ Use Management | □ Invasive Species Controls |
| □ Habitat Protection | □ Species Population Controls |
| □ Habitat Restoration | □ Erosion Control |
| □ Controlled Burning | □ Sediment Management |
| □ Planting/Harvesting | |

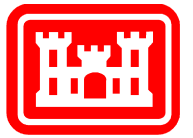
1997 Ecosystem Research Workshop Identified Research Themes for “Knowledge Gaps”



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- Indicators of Ecosystem Status
 - Ecosystem health
 - Signals of change
- Ecological Thresholds
 - Disturbance beyond unaided recovery
 - Population/habitat size
 - Species, ecosystem and landscape diversity
 - Critical zones along biogeochemical gradients

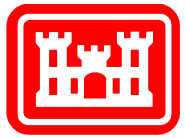
1997 Ecosystem Research Workshop Identified Research Themes for “Knowledge Gaps”



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- Role of Manipulating Biogeochemical Cycles
 - To favor one species over another
 - To promote sustainability of ecological processes
 - To promote biodiversity
 - To promote recovery
- Important of Spatial/Temporal Scales
 - In the disturbance/recovery cycle
 - In off-post/on-post relationships
 - Relationship between landscape patterns and ecosystems processes/dynamics

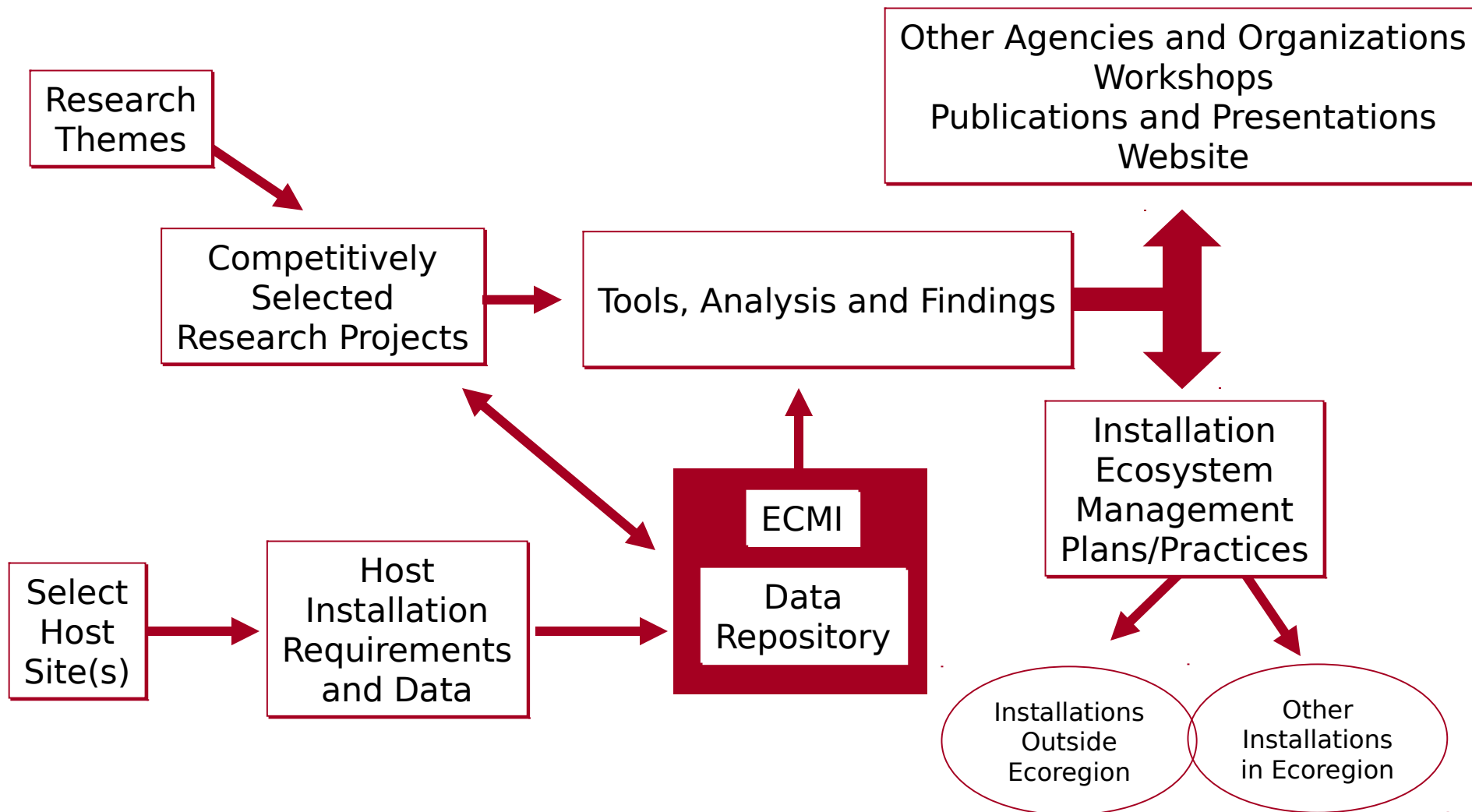
Technical Objectives



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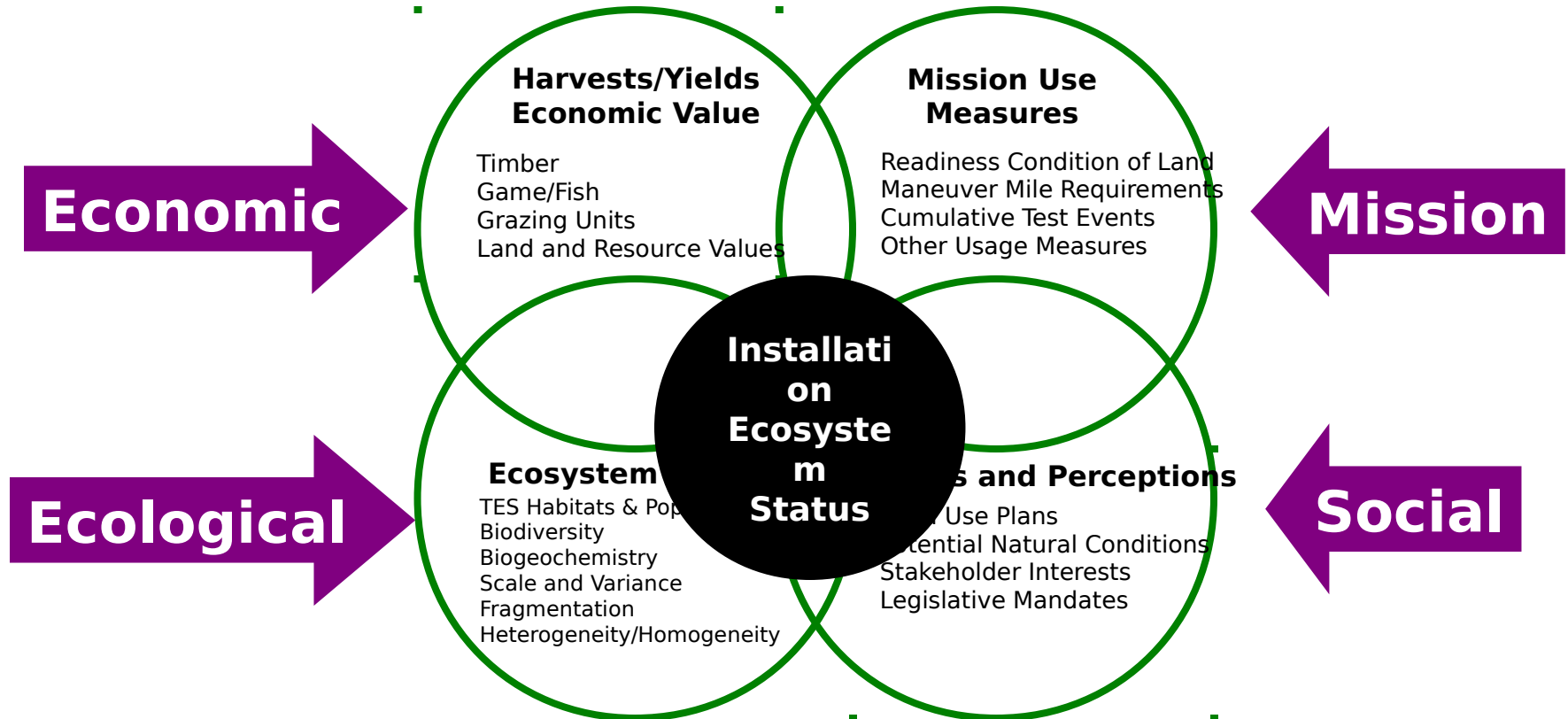
- To Address DoD Requirements and Opportunities in Ecosystem Management Research (as identified by the 1997 SERDP Ecosystem Science Workshop)
- To Establish a Long-term Research Site (or sites) on DoD Lands for DoD Relevant Ecosystems Research
- To Conduct Ecosystem Research and Monitoring Activities Relevant to DoD Requirements and Opportunities
- To Facilitate the Integration of Results and Findings of Research into DoD Ecosystem Management Practices

Technical Approach

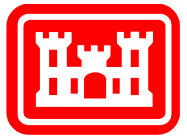


Military Installation Ecosystem Current and Potential Measures

US Army Corps
Engineers.



Why Fort Benning?



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- Large: 182,000 acres
- Enduring: Category 1 ITAM
- Home to: Multiple TES Species
- Extensive Data Sets: LCTA +
- Proactive Response to SEMP
- Numerous Military Use Stresses

Region of Interest: Southeast



- Many DoD Installations
- Ecosystem Constraints to Mission

Land Resource Areas

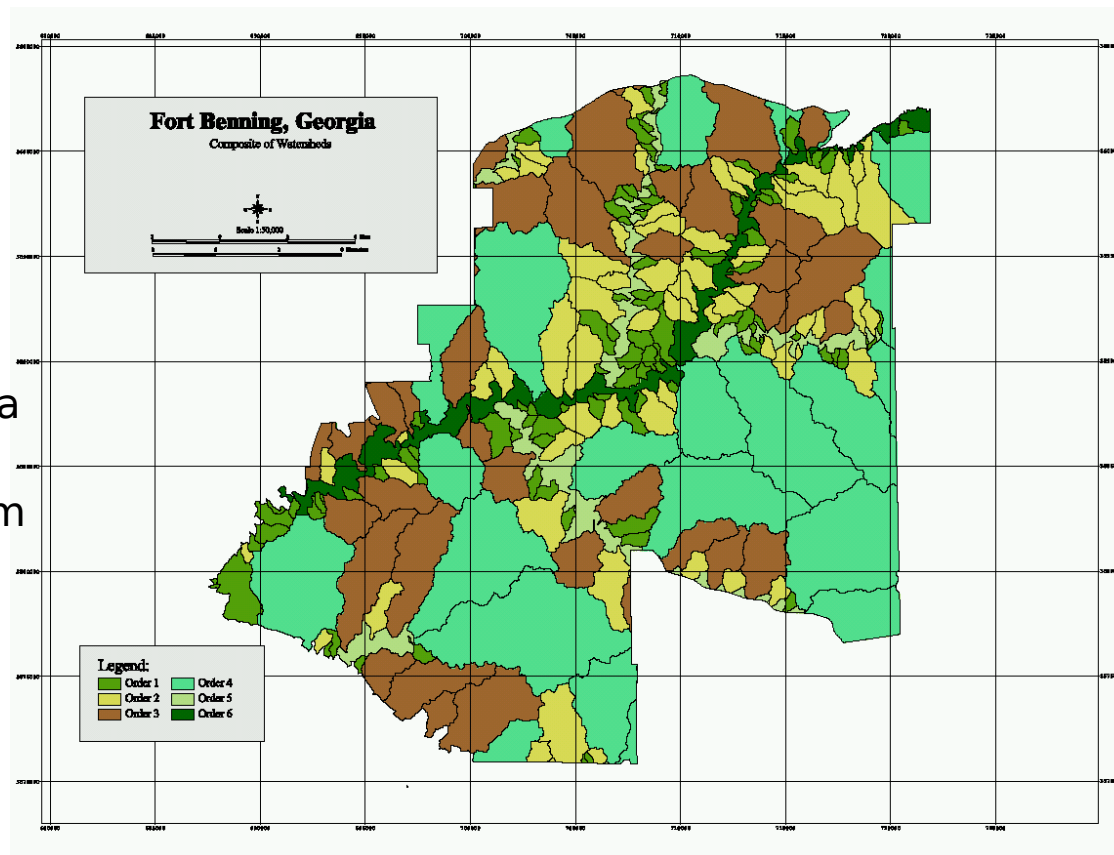


Home of Infantry



ECMI Approach

- Inventory and Document Existing Data and On-going Monitoring Programs
- Design the Baseline Monitoring Program
- Implement the Baseline Monitoring Program
- Establish and Maintain a Data Repository
- Adapt the Monitoring Program



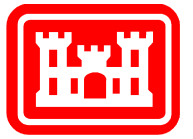
SERDP Ecosystem Management Project

Ecosystem Characterization and Monitoring Initiative

David J. Tazik, Environmental Laboratory
USAERDC, Vicksburg, MS

SERDP In-Progress Review
26 April 1999, Arlington, Virginia

Environmental Characterization and Monitoring Initiative (ECMI) Team



US Army Corps
of Engineers®

- Dr. David Tazik, EL (WES), lead
- Mr. Scott Jackson, EL (WES)
- Dr. Rose Kress, EL (WES)
- Mr. Robert Lozar, USACERL
- Dr. Jean O'Neal, EL (WES)
- Dr. David Price, USACERL
- Mr. Wade West, EL (WES)
- Dr. Adeyami, Clark-Atlanta University

Repository

- Dr. Rose Kress, EL (WES), lead
- Ms. Kelly Dilks, USACERL

ECMI -- Goal

- Design, develop and demonstrate an ecosystem characterization and monitoring concept
 - Baseline data
 - Research and land management applications
 - Demo at Fort Benning
 - Adaptable regionally and nationally

Objectives

- Characterize biotic and abiotic elements and associated processes and properties in support of ecosystem-based research and management
- Assess both spatial and temporal dynamics within aquatic, riparian, and terrestrial communities

Approach

- Inventory existing data and monitoring
- Design the baseline monitoring program
- Implement the baseline monitoring program
- Establish and maintain a data repository
- Adapt the monitoring program

1. Document Existing Data and Monitoring Programs

Milestone/Product

Date

On-site inventory

Dec 98

Regional inventory

Feb 99

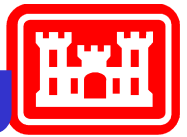
Monitoring programs

Mar 99

P: Tabular Report

Apr 99

Design Baseline Monitoring Program



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Milestone/Products

Date

Document data & info needs

Jan 99

Variable selection criteria

Feb 99

Select variables

Mar 99

Draft sampling design & protocols; submit for
external review

Jun 99

Revised design & protocols

Jul 99

P: Interim: Variable Selection

Apr 99

P: Draft: Design & Protocols

Jun 99

P: Final: Design & Protocols

Aug 99

3. Implement Baseline Monitoring Program

Milestones/Products

Date

Site suitability reconnaissance

Mar 99

Initial acquisition and procedures

Jun 99

Initial deployment & testing

Jul 99

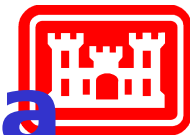
Phase 1 implementation

Oct 99

P: Phase 1 Implementation Plan

Aug 99

4. Establish & Maintain Data Repository



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Milestone/Product

Date

Repository Design

Aug 99

Phase I Repository

Oct 99

QA/QC Planning

Feb 00

P: Design Document

Sep 99

P: Phase I Repository On-line

Nov 99

P: QA/QC Plan

Mar 99

5. Adapt Monitoring Program

Milestone/Product

Date

Evaluate first year data

Dec 00

Assess adaptation recommendations

Feb 01

Implement adaptations

Apr 01

P: First year data report

Dec 00

P: Documented changes to monitoring
plan

Annual

Design Considerations

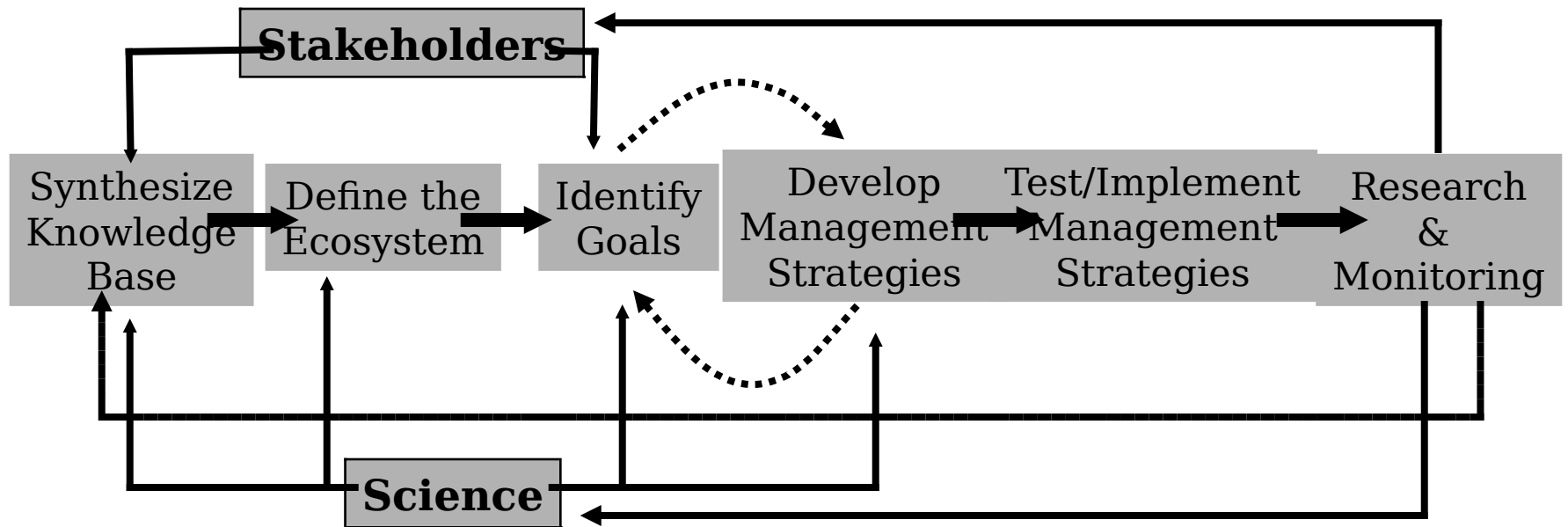
- Ecosystem Management Protocol
- Link Science, Land Management, & Data/Information Requirements
- Adaptive Monitoring
- Others

Scientific Basis of Ecosystem Management

“...management driven by goals,
executed by policies, protocols, and practices, and
made adaptable by ***monitoring and research***
based on our understanding of the ecological
interactions and processes
necessary to ***sustain***
ecosystem composition, structure, and function.”

. Christiansen et al. 1996. The report of the Ecological Society of America Committee on the Scientific Basis for ecosystem management. *Ecological Applications* 6(3):665-691.

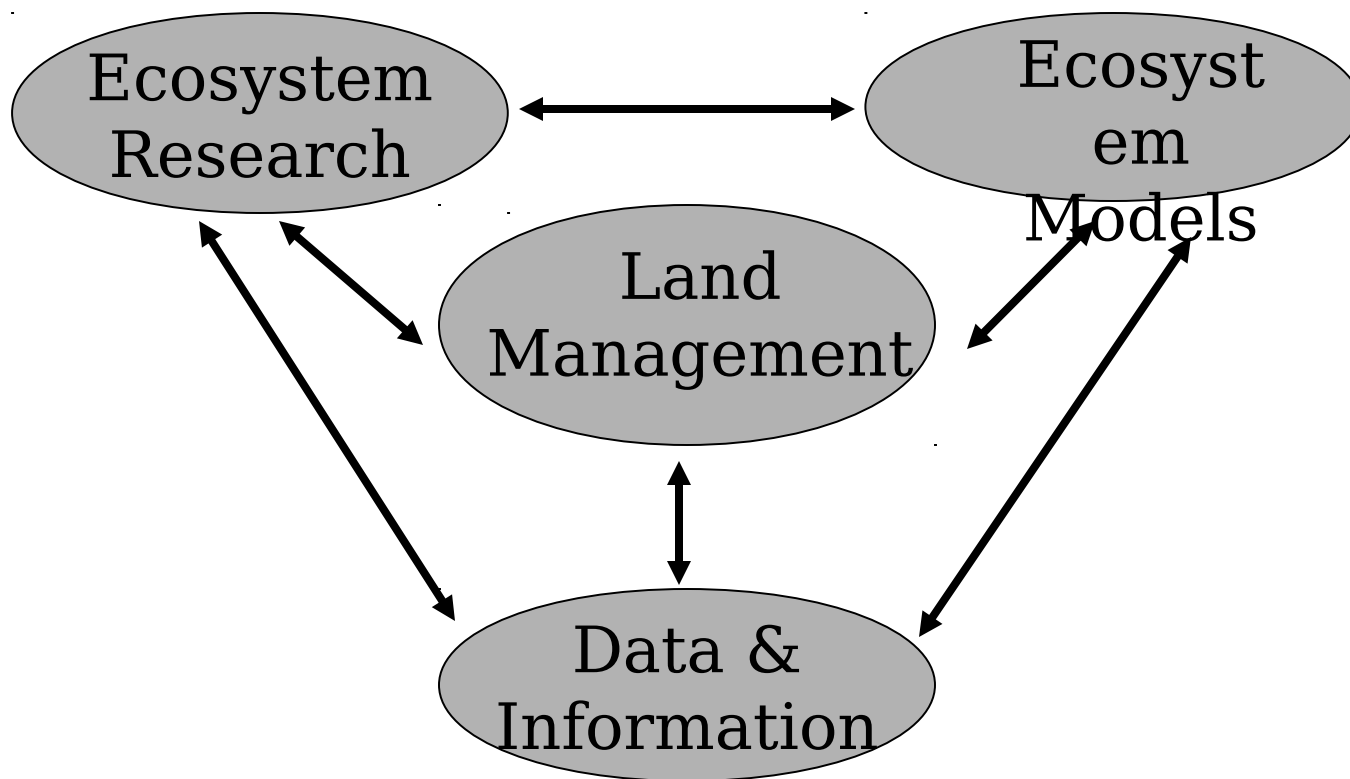
Ecosystem Management Protocol



 Management Action
  Knowledge & information flow

after J.A. Stanford and G.C. Poole. 1996. A Protocol for Ecosystem Management.
 Ecological Applications 6(3): 741-744.

Linking Science, Land Management, and Data & Information



Adaptive Monitoring

- Uncertainty re: system dynamics
- Logistical challenges
- Incorporating new knowledge (e.g. models)
- Technical and Institutional barriers
 - Qualitative objectives
 - Methodologies
 - Uncertain characteristics of environmental features
 - Priorities partially understood

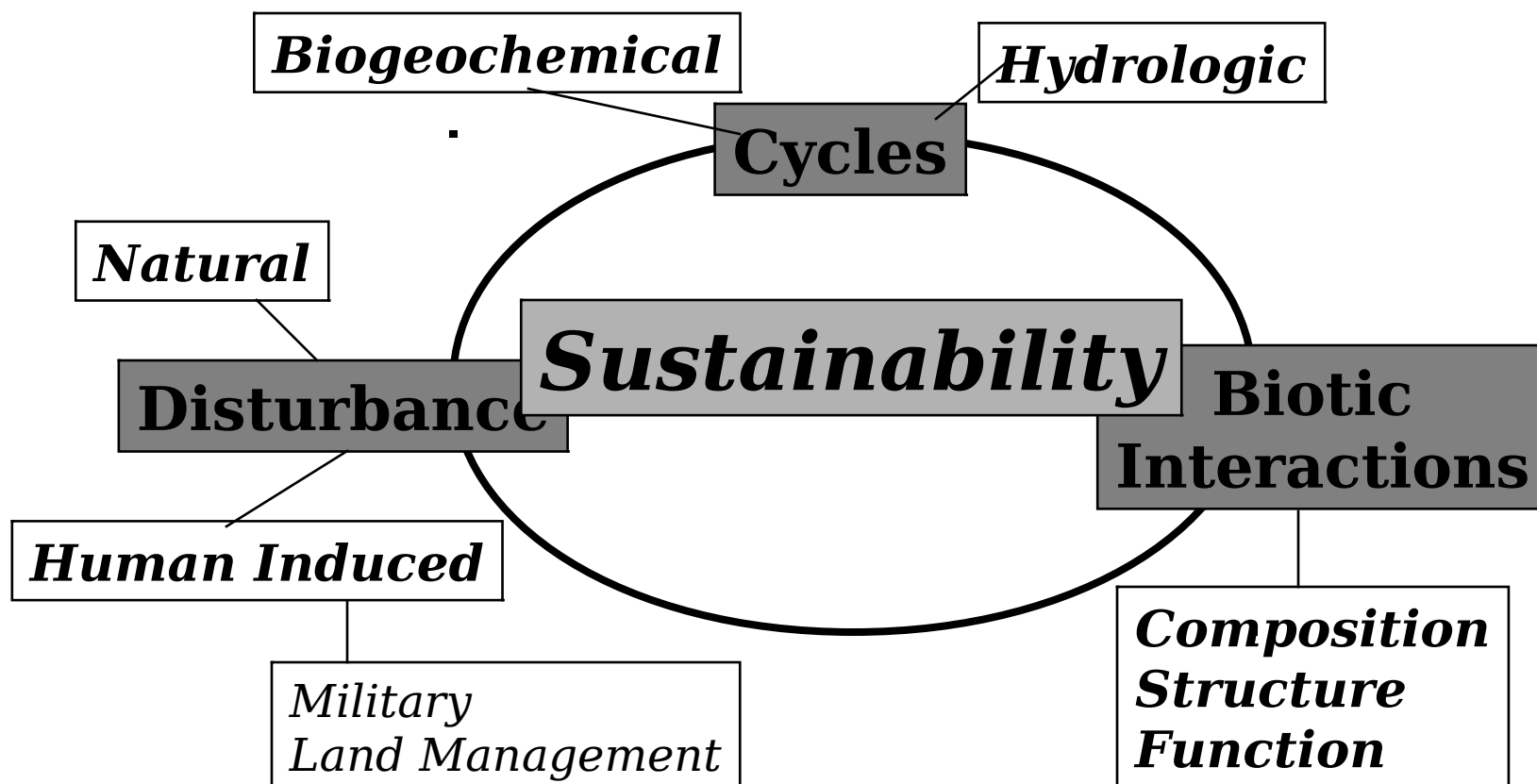
Adaptive Monitoring

- Extended design phase
- Phased implementation
 - Number of variables
 - Number of sampling units
 - Number of models addressed
- Incorporate research results
- Evaluate research and management utility

Additional Considerations

- **Scale**
 - species versus ecosystems
 - ecosystem and business processes
- **Technology**
 - minimize impact on host organization
 - rapid turnaround/accessibility
 - efficient QA/QC protocols
- **Host organization**
 - Leverage existing data collection
 - Provide value-added to installation
- **Long term commitment**
 - value of the data increases with time
- **Keep it simple & cost effective**
 - longevity inversely proportional to complexity and cost

Conceptual Framework



Variable Selection Process

- Land Managers workshop
- Researchers workshop
- Ecosystem models
- SEMP research projects
- Other monitoring programs

Priority Selection Criteria

- Ability to detect change or relationships
- Relevance to mission and land management
- Cost effectiveness
- Potential for multiple uses

Design Components

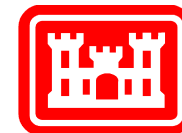
- Thematic
- Spatial
- Temporal
- Adaptive

Variable Themes

- Meteorology
- Surface Water
- Ground Water
- Soil
- Fauna
- Flora
- Land Cover
- Land Use
- Landscape Characterization
- Remotely Sensed Data

	MET	SW	GW	Soils	Fauna	Flora	Land Cover	Land Use	Land-scape	RS
Hydrologic	X	X	X				X		X	X
Biogeochem		X		X			X			
Disturbance		X		X			X	X		X
Biotic					X	X	X	X		X
Landscape Dynamics							X	X	X	X

Phased Implementation Near Term



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	FY99				FY00				FY01
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q
Meteorology			C - - - - -		M - - - - -				>
Surface Water				C - - - - -		M - - - - -			>
Ground Water					C - - - - -		M - - - - -		>
Soil			C - - - - -	- - - - -					
Fauna				C - - - - -	- - - - -		M - - - - -		>
Flora				C - - - - -	- - - - -		M - - - - -		>
Land Use/Cover			C - - - - -	- - - - -		M - - - - -			>
Landscape Characterization		C - - - - -	- - - - -	- - - - -		M - - - - -			>

Initial Deployment & Characterization

- Meteorology
 - Temperature
 - Humidity
 - Barometric pressure
 - Precipitation
 - Wind speed & direction
 - Radiation (photosynthetic)
 - Evaporation
- Surface Water
 - Stage/depth/velocity
 - Temperature
 - Precipitation
 - pH
 - Turbidity
 - Dissolved oxygen
 - Conductivity
 - NH_4 , NO_3 , CL
 - Suspended solids

Phased Implementation Phase I

- 1999: Design & Characterization
 - Inventory
 - Framework
 - Draft design & testing
 - Initial characterization
 - Focused research
- 2000: Characterization & Implementation
 - Characterization
 - Monitoring year
 - QA/QC
 - Functional repository
 - Research data flow
 - Data evaluation

Phase II-III

- II 2001-2002: Main-tain & Adjust
 - ECMI data stream
 - Conservative change
 - Imagery calibration
 - Research data stream
 - Evolving repository
- III 2003-2005: Incorporate Research Results
 - Potential major adjustments
 - Additional research attracted to site
 - Cross-site comparisons possible

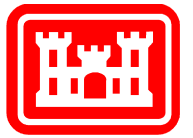
Phase IV-V

- IV: 2006-2010: Adapt to Land Management Experiments
 - Research results transferred to land management
 - Adaptive land management influences monitoring program
- V: 2011-..... Continued Monitoring

Next Steps

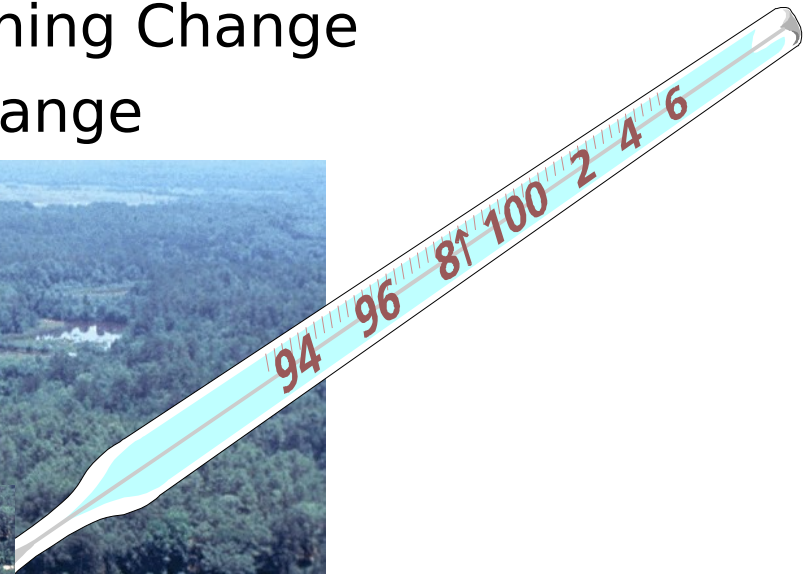
- **June**
 - Design and protocols report for external review
 - Acquire, deploy and test met and surface water stations
- **July/August**
 - Finalize design and implementation plans
 - Additional characterization work
- **August**
 - Brief Technical Advisory Committee
 - Repository design
- **September/October**
 - On-going characterization work
 - Phase 1 monitoring implementation
 - Phase 1 repository

Change Indicators SON 99 Solicitation



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- Identify and Test Potential Indicators of Change
- Define Historic Range of Variation in Indicators
- Develop Methods for Determining Change
- Identify Factors Leading to Change



Determination of Indicators of Ecological Change

Team Lead Dr. William F. DeBusk
University of Florida, Gainesville

<u>Team Member Name</u>	<u>Task/Topic</u>	<u>Institution</u>
W. F. DeBusk	Soil/Sediment/Water Quality	Univ. of Florida
K. R. Reddy	Soil/Sediment/Water Quality	Univ. of Florida
A. V. Ogram	Molecular Microbial Ecology	Univ. of Florida
D. L. Miller	Vegetation ecology	Univ. of Florida
G. W. Tanner	Vegetation ecology	Univ. of Florida
J. Jacobs	Surface Water Hydrology	Univ. of Florida
P. S. Rao	Vadose Zone Hydrology	Purdue Univ.
W. Graham	Synthesis/Modeling; Hydrology	Univ. of Florida

Determinations of Indicators of Ecological Change

William DeBusk, University of Florida

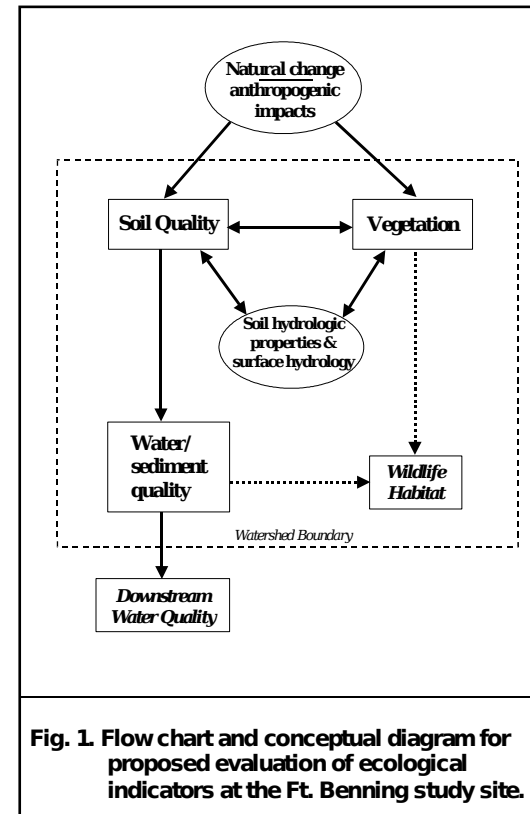
- Technical Premise
 - Soil serves as central ecosystem component linking terrestrial and aquatic habitats
- Technical Objective
 - Evaluate a suite of parameters related to properties and processes in the understory vegetation, soil and surface hydrology as potentially sensitive indicators of ecosystem integrity and ecological response to natural and anthropogenic factors

Determinations of Indicators of Ecological Change

William DeBusk, University of Florida

Technical Approach

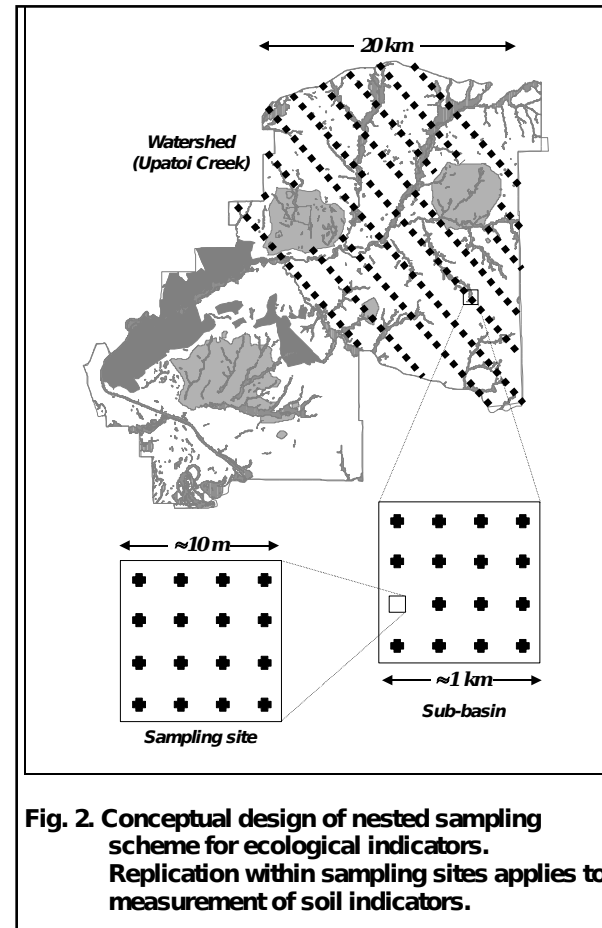
- Within a Watershed, Measure and Model Dynamics Between Vegetation, Soils and Soil Micro-organisms, Water Quality and Sediment Loads Relative to Natural and Anthropogenic Factors
- 5-year Effort



Determinations of Indicators of Ecological Change

William DeBusk, University of Florida

- Parameters to be Sampled
 - Soil/sediment physical & chemical properties
 - Enzyme activity
 - Microbial biomass
 - Microbial respiration rate
 - Vegetation
 - Hydrology
 - Stream water quality



Upatoi Creek Watershed
Selected Sub-basins

Determinations of Indicators of Ecological Change

William DeBusk, University of Florida

Milestone

Completion Date

(after funds distribution)

Project Work Plan

4 months

Installation-Wide Sampling

12 months

Low-Order Watershed Sampling (6 sites)

42 months

Intensive Sampling Along Local Gradients

42 months

Follow-up Installation-Wide Sampling

50 months

Synthesis and Modeling

56 months

Final Report

60 months

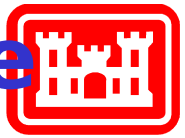
Indicators of Ecological Change

Team Lead Dr. Virginia Dale
Oak Ridge National Laboratory

<u>Team Member Name</u>	<u>Role</u>	<u>Institution</u>
Virginia Dale	Landscape Ecology	ORNL
Thomas Foster	Historic Land Cover	Penn State Univ.
David White	Microbiology	Univ. of Tennessee
Pat Mulholland	Aquatic Ecology	ORNL
Katherine Eddins	Technology Transfer	The Nature Conservancy
John Hall	Technology Transfer	The Nature Conservancy
Teresa Davo	Impact Experiments and T2	Fort Benning DOT

Indicators of Ecological Change

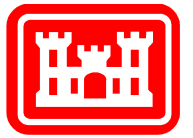
Virginia Dale, ORNL



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- Technical Concept
 - “biological integrity” or “system wholeness”
- Key Elements
 - Species Diversity - Ecosystem Function
 - Landscape Diversity - Ecosystem Structure
- Technical Approach
 - Historic Trends Analysis
 - Measure changes in biological integrity of
 - terrestrial ecosystem using a focal species approach
 - aquatic systems (land/water interactions and stream biological communities and processes)
 - soil microorganisms as a measure of the below-ground aspect of integrity
 - Perform “Impact” Experiments (with Ft. Benning)
 - Analyze Results in Terms of “Indicators”
 - Develop Tech Transfer Plan

Indicators of Ecological Change

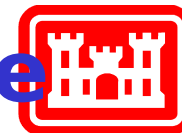


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- The technical concept, “biological integrity” or “system wholeness,” incorporates the concepts in the report from the Ecological Society of America Land Use Committee entitled, *Ecological Principles and Guidelines for Managing the Use of Lands*.

Indicators of Ecological Change

Virginia Dale, ORNL



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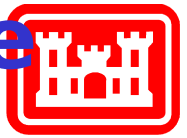
Components of Biological Integrity

Hierarchy	Elements	Processes	Suggested Indicators
Taxonomic	Species	Range expansion or contraction	Range size
		Extinction	Number of populations
Ecological	Population	Abundance fluctuation	Age or size structure
		Colonization or extinction	Dispersal behavior
	Assemblage	Competitive exclusion	Number of species
		Predation or parasitism	Species evenness
		Energy flow	Number of trophic levels
		Nutrient cycling	Elements of redundancy
	Landscape	Disturbance	Fragmentation
		Succession	Number of communities
			Persistence



Indicators of Ecological Change

Virginia Dale, ORNL
6-Year Effort



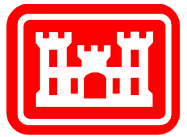
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Milestone

Completion Date

Development of candidate indicators	Nov 99
Preparation of digitized land cover and historic disturbancy map for Ft. Benning	Mar 00
Definition of focal elements at Ft. Benning	Mar 00
Report on how historical trends affect candidate indicators	Nov 00
Implementation of experiment	Nov 01
Report on critical attributes of land/water interface	May 03
Report on key soil microorganisms at Ft. Benning	Mar 03

Development of Ecological Indicator Guilds for Land Management



US Army Corps
of Engineers®

Team Lead Dr. Anthony J. Krzysik, U.S. Army CERL

<u>Team Member Name</u>	<u>Task/Topic</u>	<u>Institution</u>
John M. Emlen	Theoretical Ecology	U.S. Geological Survey
D. Carl Freeman	Plant Ecology & Physiology	Wayne State University
John H. Graham	Population Genetics	Berry College
David A. Kovacic	Ecosystem Ecology	University of Illinois
Lawson M. Smith	Geomorphology/Geology	Geotechnical Lab, WES
Ann-Marie Trame	Plant Populations	USACERL
John C. Zak	Soil & Microbial Ecology	Texas Tech University

Development of Ecological Indicator Guilds for Land Management

Anthony Krzysik, U.S. Army CERL

US Army Corps
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Technical Objective

Develop “Ecological Indicator Guilds” based on ecosystem relevant design criteria and landscape scales, for the purpose of monitoring biological viability, long-term productivity, and ecological sustainability of military training and testing lands.

Technical Approach

- Identify Ecological Indicator Guilds Based Upon Assessment of:
 - Indicator Species
 - Ecofunction Groups
 - Geomorphic Indicators
 - Developmental Instability and Plant Stress
 - Nutrient Flux
 - Microbial Functional Activity
- response to stressors
- along gradient of military use intensity

Development of Ecological Indicator Guilds for Land Management

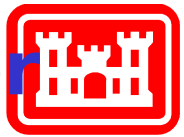
Anthony Krzysik, U.S. Army CERL

Nested Sampling Sequence

<u>Hierarchy</u>	<u>Sample Frame</u>	<u>Variance Contrasts</u>
Ecoregion	Sites	controls, gradient of disturbance
Ecosystem	Plots	uplands, riparian, lotic aquatic
Macrohabitat	Strata	habitat mosaics: patches, environmental gradients
Microhabitat	Samples	replicates

Development of Ecological Indicator Guilds for Land Management

Anthony Krzysik, U.S. Army CERL



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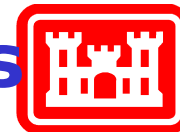
Milestone

Completion Date (after funds distribution)

Selection of study sites and plots	2 months
Selection of ecological indicators	8 months
Pilot study completed	12 m
Data assessment on military impacts on SE ecological systems	30 m
Use of Ecological Indicator Guilds for military land mgmt in southeastern United States	50 m
Applications of Ecological Indicator Guilds to southwestern, northwestern and northeastern ecoregions	60 m

Accomplishments and Deliverables

FY99 Milestones



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HOST INSTALLATION ACTIVITIES

MOU and license for facilitating work at study site

✓
03/15/99

SON ACTIVITIES

FY99 SON (Change Indicators)

Evaluation of proposals complete

✓
11/30/98

Solicitation and Review of FY00 SON (Disturbance
Thresholds)

08/30/99

TAC ACTIVITIES

Hold session of TAC for review of project plans

✓
12/15/98

Hold second TAC session for review of FY00 SON topics

08/15/99

ECOSYSTEM CHARACTERIZATION & MONITORING ACTIVITIES

Complete monitoring status report for Fort Benning, GA

✓
04/15/99

Develop plan for new monitoring activities at study site

06/15/99

Data repository design and access protocol

09/15/99

Acquisition and fielding of new monitoring equipment/stations

09/15/99

OTHER ACTIVITIES

Plan and implement SEMP Website

03/31/99 ✓

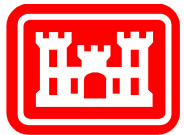
Memorandum of Understanding

- Facilitate SEMP Teams Working On-Site at Fort Benning
- Institutional Support by Installation and MACOM to SEMP
- Signed by the Fort Benning Garrison Commander; Assistant Deputy Chief of Staff for Base Operations Support, HQ TRADOC; and USACERL Director
- 10-Year Time Frame
- Requires On-Site Coordinator at Fort Benning

1st TAC Session

- Met at Fort Benning on November 18 and 19
- Reviewed Seven Proposals Forwarded from the Peer Review Group
- Accepted the Following Three Proposals
 - Determination of Indicators of Ecological Change
 - Indicators of Ecological Change
 - Development of Ecological Indicator Guilds for Land Management

Review Process for FY99 SEMP Proposals



US Army Corps
of Engineers.

Determination of Indicators of Ecological Change

7

Received: 15
Rejected: 2

6

SUBGROUP A

Ecosystem -- Terrestrial Focus

Proposals Reviewed by PRP: 7
Proposals Forwarded to TAC: 4

SUBGROUP B

Ecosystem -- Aquatic Focus

Proposals Reviewed by PRP: 6
Proposals Forwarded to TAC: 3

TAC Reviewed: 7
Forwarded: 3

Dale terrestrial
DeBusk aquatic
Krzysik terrestrial

SERDP Program
Office Review

Peer
Review
(Sept, Oct)

TAC
Review
(Nov)

November 98
TAC Workshop

1. Document Existing Data and Monitoring Programs

Milestone/Product

Date

On-site inventory

Dec 98

Regional inventory

Feb 99

Monitoring programs

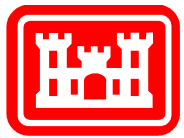
Mar 99

P: Tabular Report

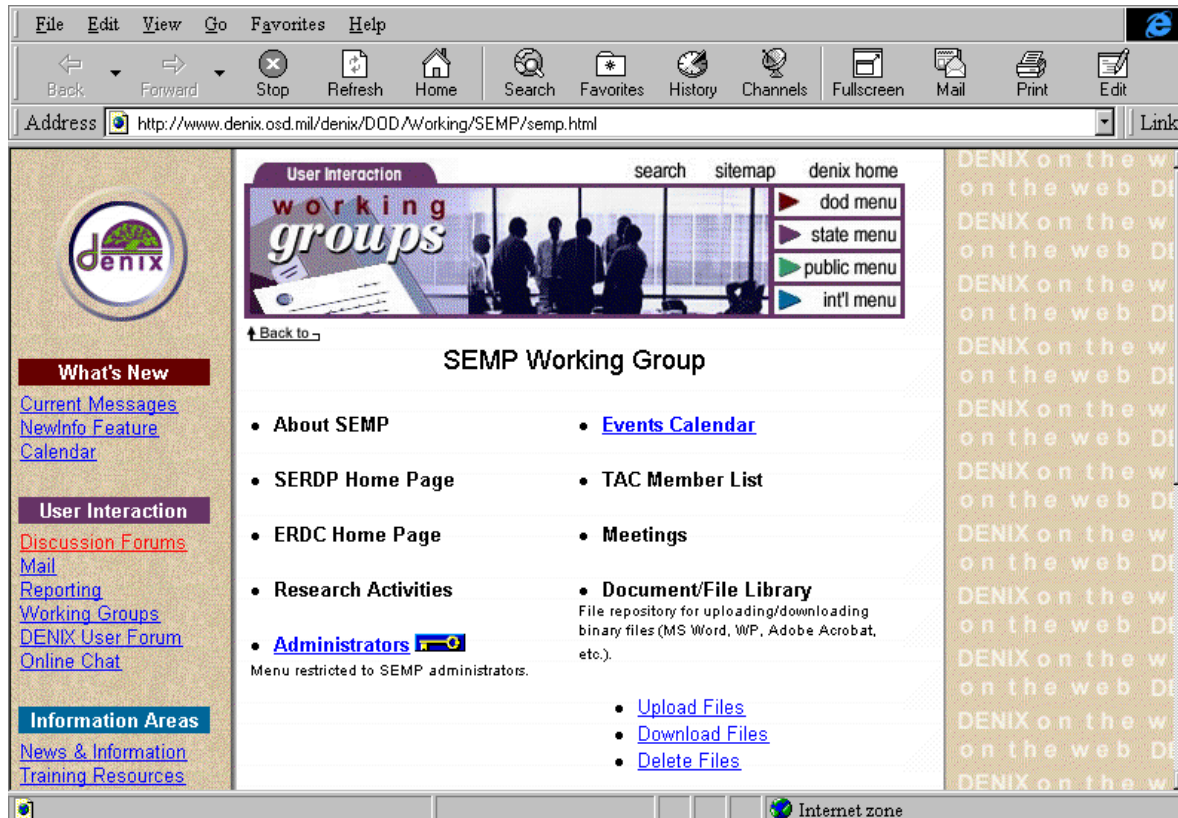
Apr 99

SEMP Website Through DENIX

<http://www.denix.osd.mil/denix/DOD/Working/SEMP/sem.html>



US Army Corps
of Engineers.



How to obtain a DENIX
logon:

- Accessing on-line
registration through DENIX
Home Page
(<http://denix.osd.mil>)
- Contact Kim Grein at
(217) 373-6790, FAX (217)
373-7270

Response to Action Items

- Consider Appropriateness of Imminent DOE Sites Already in Place
 - DOE Savannah River site conducts relevant work
 - Whitfield Gibbons is a member of the SEMP TAC and a lead scientist at Savannah River
 - Other DOE Involvement (TAC and research projects) Will Help Ensure SEMP Project Incorporates Information and Approaches from Other DOE Sites

Response to Action Items

(Relationship to On-going SERDP Projects)

SERDP Ecosystem Management Project (SEMP)

Emerging and Contemporary Technologies
in Remote Sensing for Ecosystem
Assessment and Change
Detection on Military Reservation

Collaborative Techniques

Assessment of Training
Noise Impacts on the
Red-Cockaded Woodpecker

**Expanded RCW and Mission Impact
Knowledge/Models**

Scenario-Based Planning
Effort for the Mojave Desert

**Ecological "Forecasts" for
Mgmt Options; Approach
Relevant for SE "forecasts"**

Predicting the Effects of
Ecosystem Fragmentation and
Restoration: Mgmt Models for Animal Populations

**Threshold Issue --
Collaborative Knowledge and
Techniques (different ecoregion)**

Threatened, Endangered and
Sensitive Resources

**Focus on Southeast; SEMP Building
Upon this Investment for Research
and ECMI**

Program Status

Description	Status
Management	On Schedule
Characterization, Monitoring and Repository	On Schedule
Developing Ecological Indicator Guilds (CERL)	In Progress; Cooperative Agreement
Determination of Indicators of Ecological Change (Univ. of FL)	Close to Award
Indicators of Ecological Change (ORNL)	Funds Just Received at ORNL
Host Site Coordinator	On Board 04-21-99

Deliverables

- Every 3 Years (01, 04, 07)
- Year 2 (with revisions in later years)
- Every Year
- As Planned
- Continuous Updates
- Lessons Learned Reports and Workshops
- Monitoring and Repository Plans
- Annual Monitoring and Repository Summary and Analysis
- Reports and Deliverables from Specific Research Efforts
- Website